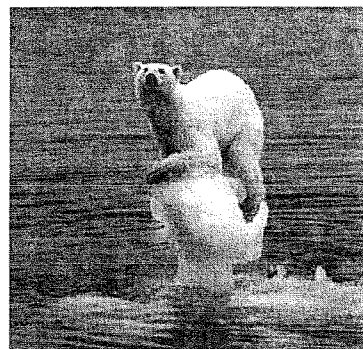


It's Not Just Global Warming Anymore: A Closer Look at the Effects of Increasing Atmospheric CO₂

Why?

As early as 1896, scientists began to hypothesize that burning fossil fuels would increase the greenhouse effect as CO₂ is added to the atmosphere. Today this is not only a fact, but also a disastrous reality the planet is facing. Most know that an increase of CO₂ increases the average temperature of the planet. Is a temperature increase the only effect of increased CO₂ the planet needs to worry about?



Learning Objectives

Students will be able to:

- Explain how increased atmospheric CO₂ affects the oceans
- Explain how increased temperatures affect the energy requirements of polar bears

Prerequisites & Resources

- Burning fossil fuels increases the amount of CO₂ in the atmosphere.
- Increased atmospheric CO₂ contributes to climate change.
- Organisms require energy for to perform life processes.
- Energy can be stored as lipids (fat).
- Organisms are closely tied together in food webs.
- Some marine organisms use calcium carbonate to build skeletons and shells.
- An increase in H⁺ ions decreases pH.
- An ion is an atom that has gained or lost electrons

Concepts/Vocabulary

- Anthropogenic
- ppm
- ion

Model 1

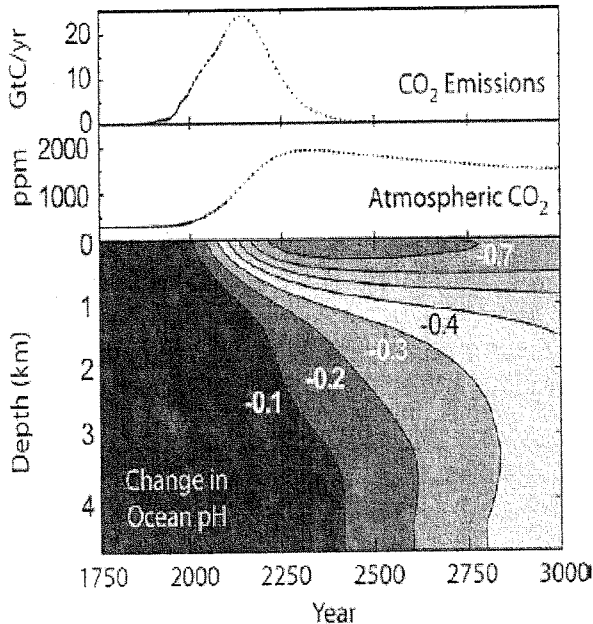


fig. 1: Three graphs illustrate anthropogenic CO₂ emissions in grams of total carbon per year (GtC/yr) (top), atmospheric CO₂ concentrations (ppm) (middle), and ocean pH (bottom). Dotted lines indicate projections based on current models.

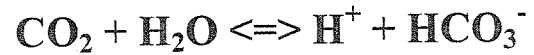


Fig. 2: The Chemistry of Dissolved CO₂ in Water:

Key Questions

1. What does the top graph in figure 1 display?
2. What does the bottom graph in figure 1 display?
3. What two ions are produced when carbon dioxide dissolves in water?
4. If more CO₂ is dissolved in water, what will happen to the amount of H⁺?
5. What does an increase in H⁺ ions do to the pH levels of the water?

6. According to the graph, what is the overall trend in ocean pH as atmospheric CO₂ levels increase?

7. Explain how an increase in atmospheric CO₂ decreases the pH of the ocean.

8. Identify two human actions that add CO₂ to the atmosphere.

9. Describe one specific negative impact you think a decrease in ocean pH could have on living things.

Model 2

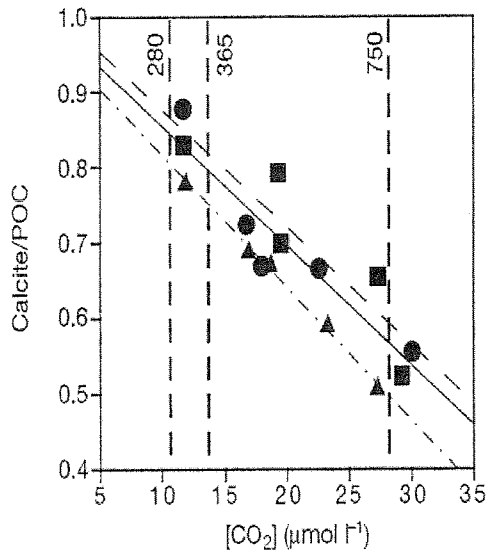


Fig 2: This graph summarizes data from 3 different laboratory experiments (Trials are shown as ▲, ■, ●) showing the effect of CO₂ on calcite levels in solution.

Key Questions

1. For the ▲ trial, what is the amount of calcite in solution when the [CO₂] is 10 μmol⁻¹?
2. According to figure 2, what happens to calcite concentration as CO₂ concentration increases?
3. What human activity is causing an increase of CO₂ in the atmosphere and marine environments?
4. Explain how a decrease in dissolved calcite would affect marine organisms that rely on it for shell and skeleton formation?
4. How do you think these changes in calcite will affect marine food webs?

Model 3

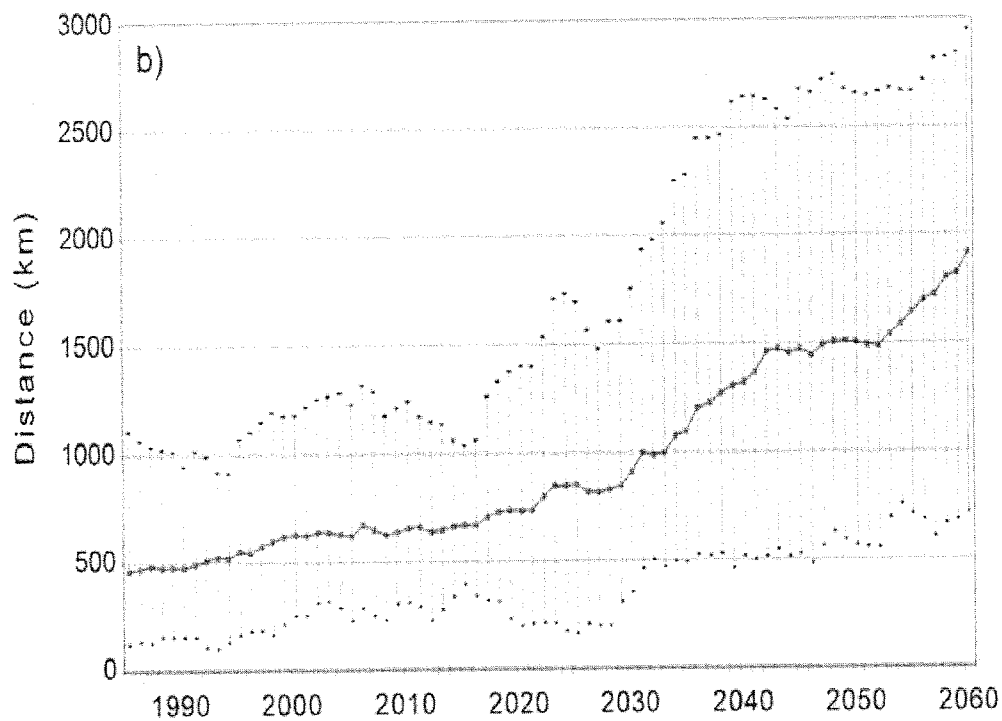


Figure 3: Average distance traveled by pregnant polar bears from foraging site on sea ice to terrestrial den site.

Key Ideas

1. What is being measured in the graph above?
2. Overall, what is the trend in distance for polar bear migration?
3. Pregnant polar bears rely on fat stores for energy during the migration to their dens. What life process is responsible for converting the fat into energy?

4. If polar bears have to travel farther during migration, what effect will this have on their fat stores and the amount of energy they have available?

5. Explain how climate change is responsible for polar bears having to travel longer distances from ice floes to their dens.

6. If polar bears use more energy (fat stores) to migrate, what effect do you think this will have on the cubs they are carrying?

6. What effect will this increased travel have on the polar bear population? Explain.

7. Even though polar bears live in Alaska, propose one local way you can help to solve the problem the polar bears are facing.

Problems

1. Most people associate increased CO₂ with global warming. Explain how global warming is not the only issue associated with increased CO₂ levels.

2. Some people have suggested that the terms "global warming" or "climate change" do not fully illustrate the entire environmental issue tied with an increase of CO₂ in the atmosphere. Propose a new term that encompasses more of the issues and explain your choice.

